



# The Audience for Science in Eighteenth-Century Edinburgh

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## THE AUDIENCE FOR SCIENCE IN EIGHTEENTH CENTURY EDINBURGH<sup>1</sup>

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The notion that science has an audience would seem to imply that science is, in some sense, a performing art, analogous to the theatre or concert music. Certainly, I want to suggest the value of seeing science as *inter alia* a form of organized public culture. Science has its performers and it has its audiences. It has, of course, its ideas—as do other forms of cultural activity. But a collection of ideas does not define a culture. A full historical and sociological appreciation of a mode of cultural expression would take into account the network of relations which connect ideas, performers and audiences in all permutations.<sup>2</sup>

A conviction that scientific ideas are special, that they are not to be dealt with by the historian on the same plane as ideas in theatre or football, is not at issue here. The assumption that scientific ideas are objective statements about physical reality, with universal validity, does not entail the judgement that scientific *culture* is unitary or that such culture is to be completely comprehended without considering the particular contexts in which it has flourished. Science always bears a relation to the culture of which it is part, and culture demands for its understanding careful attention to the social context. As the audience for science is part of its cultural definition, and as the nature of the audience arises from the particular social context, it becomes interesting to ask whether an external audience may condition, influence or direct local scientific enterprises. May we look to the local audience for partial answers to questions which are central to the concerns of the social historian of science?—Why do men of science address themselves to the problems they do?—On what terms and for what reasons does society support, value and encourage scientific activity?—What are the mechanisms of scientific institutionalization and professionalization?—Is the sociology of scientific knowledge possible?

This preliminary study of the relations between scientific performers and the non-expert audience in one particular social context is an attempt to do two things: to add another dimension to the social history of science, and to justify and provide a programme for local studies of scientific enterprises. No claims are made for the novelty of seeing scientific activity in terms of performers and audiences. Nor should such a notion, even if it seems valuable,

claim status as a *model*. The terminology arises from observation that participants in scientific enterprises often spoke and thought about their situation in this, or similar, ways. On the other hand, one would not want to set arbitrary limits on the utility of the approach; especially, one would wish to leave open the question whether the significance of an external audience disappears upon the achievement of 'professionalized' status in science. A number of studies have demonstrated that, even when 'professional' scientists are not directly and obviously addressing themselves to an external audience, their activity may reflect the cultural concerns of that audience.<sup>3</sup>

The following examination of audiences and performers in eighteenth and early nineteenth century Edinburgh mainly deals with science in a pre-professionalized state, *i.e.* a situation where men of science do not themselves control a 'critical mass' of strategically placed organizational roles and where they do not maintain impermeable social or intellectual boundaries around their activities. It is in a situation like this that one may most readily show the power which external audiences exert on scientific activity. Consideration of the audience for science is pointless if it cannot be shown that the audience is active rather than passive, influential rather than submissive. Appreciation of the role of the audience is further enhanced if, as was the case in eighteenth century Edinburgh, the distinction between it and the category of performers was often hazy. In the body of this paper I shall deal with the landed classes and their connections as the audience, but in several instances (one of which I discuss) members of the landed audience themselves perform. The categories are partly empirically observable and partly functional methodological principles.

But it is the concept of *power* residing with the audience for science which is crucial to the exercise. Without an empirical demonstration of the nature of the audience's power over a scientific enterprise, attention to the local audience again becomes meaningless. Power need not be crudely coercive, nor need the application of audience power *determine* scientific activity, its social organization or intellectual structure.<sup>4</sup> If another metaphor is required, it would be that of charades, where performers and audience can reverse roles and are engaged in an activity with common goals, rather than, for example, the cinema, where the audience merely holds the options of attending or not; applauding, hissing or remaining silent. Power, of various sorts, was lodged with the Edinburgh audience for science, but, in the final analysis, its most important effect was to make scientific performers *identify*—socially and intellectually—with the concerns of their audience.

In the sections which follow I shall first trace some general features of the social development of local science, then discuss certain of the cultural concerns of the landed classes. Finally, I shall present evidence of the influence of the landed audience on the Edinburgh scientific enterprise in three specific areas—the fields of natural enquiry which were encouraged by the

local audience; audience power over the resources for scientific institutionalization and professionalization; and possible connections between the nature of the audience and styles of scientific activity.

## II

One approach to the question of localism in the history of science would recognize contextual factors as significant in the origins and early phases of a scientific enterprise, becoming less worthy of attention as the enterprise (or some segment of it) professionalizes, and, presumably, develops its own internal standards, structures and references. Local society, in this view, may be regarded as a reservoir, more or less full of social and political resources, on which professionalizing science draws. Once science has achieved full professionalization, contextual factors become trivial or irrelevant and can, according to such an interpretation, be ignored.<sup>5</sup> The role of the local social context can then be argued to be predominantly rate-controlling; idiosyncratic local contextual factors may influence the dynamics of scientific professionalization but not much else of interest to the social historian of science. However, such an approach rests upon a certain view of what science is—that science is properly speaking universal,<sup>6</sup> that clear boundaries can be drawn around scientific and other sorts of knowledge, that interactions between men of science and other literate individuals are primarily important in terms of the flow of knowledge from the former to the latter.

Whatever reservations one may have about this, or similar, views of the nature of science as a social enterprise, it is clear that such a line may be pursued with some success. It has been adequately demonstrated that a significant part of Edinburgh science in the mid-eighteenth century took its origins from and was centred on the activities of the University Medical School. It was through the work of medical professors and other physicians that many Edinburgh sciences, *e.g.* chemistry, botany, physiology, rose to eminence. The origins of the Edinburgh Medical School in the 1720s illustrate the significance of local contextual factors in nascent professionalism. The Town Council, comprising thirtythree representatives of Edinburgh's trade and merchant guilds, elected to develop and sustain a centre of medical teaching and clinical research largely because of local economic considerations. Improvement of the University's teaching reputation, initially in medicine but later in the arts and legal faculties, served the mercantilist function of keeping Scottish students at home and attracting free-spending English and Colonial students. Such local and contingent economic factors nevertheless provided the medical community with the financial resources and institutional bases required for the articulation of internal intellectual and professional standards. The Town Council patronized the enterprise but did not significantly interfere with its teaching or practice beyond its role in creating new chairs and wisely filling vacancies in existing ones. Thus, by the 1750s

a well-defined Edinburgh medical profession was emerging, able to push and prod its patrons in the direction it thought best and no longer just the passive recipient of external pushes and prods.<sup>7</sup>

The development of an internal professional reference for Edinburgh medical science is illustrated by the founding in 1731 of the Society for the Improvement of Medical Knowledge, led by Professor Alexander Monro I and comprising all the medical professors of the University and many of the leading members of the Edinburgh Colleges of Physicians and Surgeons. In 1734 a *student* Medical Society was instituted and later incorporated by Royal Charter in 1778. The professionalization of Edinburgh medical science is further indicated by the proliferation of specifically medical societies and clubs later in the eighteenth century and in the early nineteenth century—the convivial Æsculapian Club (1773), the Harvian Society (1782), and the Medico-Chirurgical Society (1821). Thus one can argue that the concerns of patrons and consumers of medical knowledge, founded on contextual economic and political factors, had the initiatory effect of encouraging the development of a medical profession which quickly developed its own distinctive intellectual standards and values.<sup>8</sup>

It is proper to place emphasis on the medical community in eighteenth century Edinburgh, to locate its institutional centre in the University Medical School, to stress its professional development and its contributions to non-medical areas of science. However, while medicine was certainly the cornerstone of the Edinburgh scientific enterprise and its crowning glory in mid-century, it was just as certainly not the whole of Edinburgh science. The notion of the local scientific community as a developing profession, insulated from contextual forces, does not greatly aid our understanding of the total scientific culture of the city. In the University Medical School of the 1730s there were approximately nine professors and, when one adds the scientifically-inclined physicians and surgeons of the Royal Colleges, one has something like a 'critical mass' of performers from which a professional community may be constituted. But in non-medical areas of natural knowledge, *e.g.* in mathematics, natural philosophy, and natural history, there was either just one professor commissioned to deal with the subject, or, as was the case with geology, none at all. So it is evident that neither the University nor any other specialized institutional venue provided an insulated forum for the cultivation of sciences other than the medical.

While Edinburgh medicine and related sciences acquired an audience of expert peers during the eighteenth century, the rest of the local scientific enterprise remained crucially dependent on the participation of an audience which was similar to the audience for any other area of literate culture. Indeed, if one looks at the organizational tendencies of local science as a whole, one sees that institutional specialization and social separation are not the dominant processes—quite the reverse.



In 1783 the Royal Society of Edinburgh was established as a forum for the “cultivation of all branches of science, erudition and taste”, with ‘Physical’ and ‘Literary’ Classes of approximately equal size and intended to be of equal importance. The Royal Society of Edinburgh’s organizational predecessors may be traced at least as far back as the previously mentioned 1731 Medical Society. The Medical Society’s published *Essays and observations* indicate an exclusive preoccupation with clinical medicine and closely allied subjects. But the Society was too dependent on the energies of Professor Monro and when he fell ill late in 1735 the group seemed on the verge of dissolution. Monro’s friend and colleague, Professor of Mathematics Colin Maclaurin, seized the opportunity to transform the specialized Medical Society into the intellectually broader and socially more inclusive Philosophical Society of Edinburgh (or the Society for Improving Arts and Sciences, and particularly Natural Knowledge). Whereas the Medical Society included only those with a professional interest in medical science, the 1737 Philosophical Society’s rules specifically provided for the inclusion of fifteen members (a third of the total) who should be “Gentlemen who do not make Philosophy or Physick their particular Profession”. By mid-century the Society’s officers included learned lawyers, literary divines, and great improving landowners, as well as the expected preponderance of medical professors and practitioners.<sup>10</sup> Its intent was to cater for the study of national antiquities and polite learning as well as for physics, mathematics and chemistry.<sup>11</sup>

This transformation manifests the local realization that the nascent scientific community was indeed reliant on the patronage, approval and support of a non-professional audience. It further demonstrates that Edinburgh science was exoteric by choice, not solely by the nature of the institutional constraints placed upon it. A scientific enterprise which could show its valuable participation in the general ‘improving’ thrust of Enlightenment culture might take its place with mental and moral philosophy, history, and the study of agricultural practice at the centre of Edinburgh’s cultural concerns.<sup>12</sup> The ‘improving landlord’ was seen to have his parallel in the ‘progressive man of science’; rational scientific knowledge became an appealing mode of culture to the non-specialist partly because it seemed to legitimate modern-minded activity in other spheres and because it could be argued to contribute to improvement in technique.<sup>13</sup> Agricultural improvers often regarded theoretical science as a cultural cachet, enhancing their anti-traditional, progressive self-image. They also frequently attempted to use natural knowledge as a tool, particularly as a guide to improved practice.

An over-view of the institutional position of eighteenth century science in Edinburgh reveals no instance where the practitioners of natural knowledge urged its separateness from general cultural concerns, nor any organization, apart from those devoted to medicine, which was concerned to

propagate scientific culture in an esoteric, socially exclusive manner. The transformation of the sixty-member Philosophical Society of 1782 into the 145-member Royal Society of 1783 further illustrates this exoterizing tendency of local science. Fully sixty percent of the founding Fellows of the Royal Society of Edinburgh could not be described as men of science by any definition. And even when, by the early years of the nineteenth century, the Society had become a *de facto*, although not a *de jure*, scientific society, its officers and active participants were still often drawn from the circles of literary lawyers and improving landlords. As late as 1857 it was estimated that only eightynine of the two hundred and eightynine FRSES were “truly . . . engaged in the pursuit of science”.<sup>14</sup> Well into the nineteenth century the audience for general science in the Royal Society of Edinburgh remained a non-specialist audience. The common bond was interest in natural knowledge; expert performer and non-expert audience were drawn into a social circle by an appreciation of the various values of this form of cultural activity. The inclusive character of the Society was not lamented by its scientific leaders. In the 1860s, by which time London science was increasingly conducted in specialized societies for the expert geologist, chemist, entomologist, etc., James David Forbes (physicist and vice-president of the Royal Society of Edinburgh) argued that the Society ought not exclude the dilettante and the amateur. “An artificial standard of literary and scientific distinction”, he said, should not be “held up as regulating the entrance or refusal of candidates”. Fellows should not be selected “for intellectual attainment alone, and forming therefore a learned class”:

Whatever disadvantages may attend the admission to Societies like this of persons who have no pretention to what, for convenience, one may call a *professional* acquaintance with science, art, or literature, I think that they ought to be eligible . . . I say, Let them come and freely, and let us regard their adhesion to our ranks as a compliment on either side.<sup>15</sup>

In 1830 David Brewster defended the utility of a general audience for science by pointing out that “it is no small object to bring together the scientific men of a large city, and the gentlemen of rank and official dignity . . . Science gains greatly by this indirect patronage”.<sup>16</sup>

Remarks like these by Brewster and Forbes are not isolated instances. Specially noteworthy as they come from men of science in the vanguard of the movement to secure professional status for British science, they prompt us to take seriously the concept of the audience for Edinburgh science and to search in this notion for insights which may inform local studies in the social relations of the enterprise. Even if we accept that there was a species of eighteenth century Edinburgh science, namely medicine, which did develop its segregated institutional venues, there remains a large area of enquiry. Why was it that the great body of natural studies, despite their intellectual

vigour during the eighteenth and early nineteenth centuries, did not move significantly towards securing a specialist audience? What sorts of influences on the scientific enterprise may its audience have exerted? How did scientists themselves, as scientists and as intellectuals, relate to the conditions of their local existence?

### III

From the 1720s well into the nineteenth century the audience for much of Edinburgh science remained an audience, not just of expert peers but also of the landed and traditional professional classes which participated in and patronized literate culture in general. In this section I shall briefly outline the composition and concerns of the landed segment of the local audience for natural knowledge; in the next section I shall outline a set of questions which take the concept of the local audience into account and which are central to the business of the social historian of science.

All examinations of the social composition of Edinburgh Enlightenment culture have laid considerable stress on the role of the Lowland landed classes, their connections and their concerns.<sup>17</sup> Not remarkably significant as intellectual performers, although some of them made creditable contributions in a number of areas, the landed classes and the prestigious lawyers, to whom they were related by birth and social standing, were indispensable as beneficent patrons of Edinburgh's cultural endeavours. Few cultural organizations flourished if they could not interest and involve substantial numbers of aristocrats, gentry and legal lords. Nor was any cultural enterprise in which they were represented untouched by the reference intellectual performers were pleased to make to the landed classes' over-arching concern—the 'improvement' of the Scottish nation, most importantly via the modernization of agricultural techniques and production, but also through the general improvement of Scottish philosophy and letters. Economic progress and intellectual progress were linked in the cause of cultural nationalism. These two strands of the improving impulse, bound together in the hands of the powerful landed classes, form the warp on which the fabric of Scottish Enlightenment culture was woven.

For the present I should like to pick up the strand of the agricultural improving tendency among the landed classes and follow its course through eighteenth and early nineteenth century culture. Great aristocrats like the Duke of Hamilton and the Earl of Hopetoun; legal lords like Henry Home, Lord Kames and John Campbell, Lord Stonefield; lesser gentry like the Clerks of Penicuik and James Hutton, Berwickshire farmer and geologist, all felt the impulse to improve the agricultural productivity of Scottish soil and to enhance their own economic power by increasing the rent-value of their estates. Legal reform, especially the elimination of feudal land-tenure, was the essential precondition for achieving economic progress on the model of



Norfolk, Dorset and the Low Countries. But the extermination of run-rig farming meant little without the application of scientific and technological knowledge which was widely perceived as necessary to a rise in productivity.<sup>18</sup> This demand for new knowledge and new techniques—in ploughing technology, new crop varieties, methods of rotation and satisfying explanations of the principles of plant nutrition and fertilization—was significantly reflected in the direction and organization of Edinburgh culture from the 1720s onwards.<sup>19</sup>

No act of crude coercion was required for the concerns of the improving landlord as a member of the cultural audience to be translated into the pre-occupations of the expert scientific and technological performer. Improvers were very much the ‘culture heroes’ of eighteenth century Scotland, widely seen to be the figures alone capable of leading Scotland out of the dark economic and cultural age of the period immediately following the 1707 Union with England. Intellectuals of all sorts were anxious to join forces with them and to participate in what was simultaneously a cultural and a patriotic exercise.

The improving movement in agriculture found its first local organizational expression in The Honourable the Society of Improvers in the Knowledge of Agriculture in Scotland, founded in Edinburgh in 1723 and continuing in some vigour until the uprising of 1745.<sup>20</sup> Its membership of approximately three hundred included the Dukes of Hamilton, Athole and Perth; twentyone Earls; seventy other titled gentlemen; nearly all of the Senators of the College of Justice; fifty other advocates; and ten Writers to the Signet. From among the University of Edinburgh professoriate the ‘Improvers’ included Professor of Anatomy Alexander Monro I, Professor of Botany George Preston and Professor of Mathematics Colin Maclaurin. Its Secretary was Robert Maxwell of Arkland, a land-valuer and writer on practical agriculture who made serious efforts to have a lectureship in agriculture instituted in the University of Edinburgh. The great, improving landowners in the Society demanded for their consumption not only new, anti-traditional practice but practice which could be seen as ‘rational’. “Agriculture”, Arkland claimed, “certainly comprehends more parts of Philosophy than any other Profession, Art or Science in the world”. In the Society’s view, agriculture not only comprehended science, it was urged to *be* a science and should be “taught in a College-way, as other Sciences are”.<sup>21</sup>

This public, institutionalized alliance between agricultural improvement, powerfully urged by the august landed audience, and the rationalizing impulse of scientific intellectuals proved to be an enduring and pervasive one in the social relations of Edinburgh culture. The Edinburgh Philosophical Society, whose Presidents during its fortyfive year career were the improvers the Earl of Morton and Lord Kames, initiated a scheme in the 1740s whereby landed gentlemen desiring expert assays of ores, minerals and soils might

submit samples to its Secretary, Professor of Chemistry Andrew Plummer.<sup>22</sup> The assays would be performed free of charge, in the expectation that the results would prove equally beneficial to the science of chemistry and the economic position of the improving landlord. Lord Kames—literatus, judge and agriculturist—enlisted the technical assistance of many scientific performers before the Philosophical Society in the same cause. His book, *The gentleman farmer*, published in 1776, contains solicited advice of Professor of Chemistry Joseph Black, Professor of Medicine William Cullen and future Professor of Natural History John Walker, among others. Never relaxing his efforts to link natural science and agricultural improvement to the advantage of both, Lord Kames advocated the formation of a Board of Agriculture, pointing out the salutary influence such a body might have on the advance of knowledge:

The Royal Society at London [he claimed]; and similar societies in different parts of Europe, are found of great utility for promoting and propagating knowledge. Every man ambitious of making a figure by enlightening others, has a learned society to apply to, who kindly receive his work and publish it to the world under their patronage. In a country where such an institution does not exist, men of genius having little incitement to exert themselves, remain in obscurity, and their slight attempts die with them.<sup>23</sup>

Yet even in the absence of a national Board of Agriculture, there were in mid-eighteenth century Edinburgh a variety of organizations where a man of science desirous of “making a figure by enlightening others” might find an audience receptive to natural knowledge related to the productivity of the land. The Board of Trustees for the Encouragement of the Fisheries, Arts and Manufacturers, of which Lord Kames was a leading light, evolved out of the Society of Improvers and supported surveys and experimentation in areas related to agriculture throughout the eighteenth century. A number of scientific professors at the University of Edinburgh performed technical tasks under the Board’s auspices, including William Cullen.<sup>24</sup> In the 1750s the illustrious Select Society spawned the satellite Edinburgh Society for Encouraging Art, Science, Manufactures and Agriculture which awarded prizes for essays and innovations in agriculture and other areas of economic concern. Another off-shoot of the Select Society was the Edinburgh Society for the Importing of Seeds of Useful Trees which stimulated afforestation and the planting of horticulturally valuable varieties. Edinburgh professors sometimes supplemented their incomes by offering private or public lectures on agricultural topics to audiences of landowners and estate agents, as did William Cullen (himself a small-scale farmer) in 1758 and John Walker in 1789.<sup>25</sup>

The organizational fulfilment of the eighteenth century covenant between

scientific performers and improving landlords was reached in 1784, with the institution in Edinburgh of the Highland and Agricultural Society. This enormously influential and prestigious body, whose membership had grown to five hundred by 1800, had as part of its brief the "improvement of the Highlands . . . by advancing agriculture, and extending fisheries".<sup>26</sup> Several Edinburgh scientific professors made contributions to its *Transactions*, including Professors of Natural History John Walker and Robert Jameson and Professor of Chemistry Thomas Charles Hope. The latter's article attempted to apply techniques for determining the specific gravity of liquids to an assay of the richness of milk. Professor of Agriculture Andrew Coventry exerted himself notably on the Society's behalf, besides enriching himself as an agricultural consultant.

#### IV

My emphasis on the landed elements in the audience for Edinburgh science and my concentration on their agricultural concerns arise from an attempt succinctly to introduce the concepts of power and authority as they relate to the local scientific enterprise. Certainly, I am not claiming that the landed classes constituted the whole of the audience for science, nor that their agricultural interests were the only ones reflected in the activities of Edinburgh men of science during the eighteenth and early nineteenth centuries. Nor, it should be clear, am I asserting that there were no occasions on which roles were reversed—when members of the landed classes responded to the cultural power of the literati and when the activities of landed gentlemen ought to be explained in terms of their identification with scientific intellectuals. There are in fact a number of such instances and attention to the functional nature of audience and performer roles is essential to an understanding of Scottish Enlightenment culture. Yet, for the sake of simplicity in introducing these explanatory principles, I must return to discussion of landed society in the Edinburgh audience. Participation of the landed classes in Edinburgh culture was immensely important, especially so as cultural, political and social power was significantly located in these sections of Scottish society.

With these necessary caveats in mind, we can now proceed to outline a number of areas in which attention to the role of the audience and the relations between audience and performer may inform local studies in the social relations of science. These are (1) foci of interest; (2) institutionalization and professionalization; (3) styles of scientific activity. I shall treat the first two areas in greater empirical detail than the third, where I shall briefly speculate about possible lines of research.

##### (1) *Foci of interest*

Historians of science have been concerned for some time to formulate accept-

able explanations of why scientists address themselves preferentially to certain areas of natural enquiry; in other words, to understand the dynamics and thematics of scientific enterprises. Without doubt, an important element in scientists' problem selection is a purely intellectual one—certain lines of research are perceived to be more 'fertile' or 'rewarding' than others. But intellectually fertile areas of enquiry, according to this view, ought to be universally identifiable; scientists in any particular country or region should not show particular sensitivity in recognizing such areas.<sup>27</sup> And yet regional and national differences are found to exist in the thematics of scientific activity. Social historians of the seventeenth century Scientific Revolution have persuasively documented that English science 'clustered' in certain areas, such as mechanics, hydraulics, and astronomy, and have been drawn to attribute this clustering at least partly to the relation between the 'internal' conduct of science and the concerns of merchant capitalism.<sup>28</sup> Robert Merton's thesis, although not Boris Hessen's, about the relationship of thematics to context was carefully qualified; science neither reflexively responded to economic 'demand', nor was science argued to be a kind of search-light which automatically solved the problems to which it was directed by postulated economic needs.<sup>29</sup> However, Merton's collective biographical methodology and his contextual approach is not less valuable for these limitations. Due appreciation of his work has suffered, on the one hand, from infatuation with seventeenth century England and, on the other, from attempts to render his thesis into a sociological abstraction when it might be better served by empirical testing against other concrete and defined contexts.<sup>30</sup>

If, in 1760, a visitor to Edinburgh had been asked which scientific discipline he most closely associated with the city, his answer would very likely have been either "medicine" or "chemistry". However, if, in 1810, a visitor had been asked the same question, he would have been far more likely to reply "geology". Historians are generally familiar with the theatrical and acerbic public duels between Edinburgh Huttonians and Wernerians in the early decades of the nineteenth century. Certainly the gladiatorial character of these debates, involving the generally literate as well as men of science, would have led to an identification between Edinburgh and the earth sciences. But there are sure quantitative bases for assessing the intensity of the connection between local culture and geology, mineralogy and meteorology. The published *Essays and observations, physical and literary* (3 vols, 1754–71), which are the partial records of the Philosophical Society's proceedings, contain scarcely any material directly relating to the earth sciences (although there is suggestive evidence that contributions to the Society were made in these areas). However, the institution of the more prestigious Royal Society of Edinburgh in 1783 had, according to Professor Playfair, "the good effect of calling forth from Dr [James] Hutton the first sketch of a theory of the earth, the formation of which had been the great object of his life". It was "his zeal in supporting a



recent institution which he thought of importance for the progress of science in his own country” which elicited from Hutton his outline *Theory of the earth* which was communicated to the Royal Society of Edinburgh in March and April of 1785.<sup>31</sup> It was the stimulating effect of Hutton’s system that David Brewster was referring to when, in an address to the Royal Society of Edinburgh, he asserted that “geology, as a science, drew its first breath within our walls”.<sup>32</sup>

Hutton did not intend that his largely deductive system should give rise to an experimental research programme and it is even unclear to what extent he regarded empirical testing as desirable.<sup>33</sup> But, by the late 1790s, the earth sciences had seized the imagination of large numbers of Edinburgh scientists and their audience. From 1785 until 1808 the Royal Society of Edinburgh was unchallenged among local cultural societies as a public forum for debate in geology and related sciences. In the first three volumes of the *Transactions of the Royal Society of Edinburgh* (1788–94) approximately one-quarter of the articles dealt with geology, mineralogy and meteorology. By 1812–15 (volumes v–vi) this fraction had risen to over one half. These rough figures clearly underestimate the extent of activity in the earth sciences in both the Royal Society of Edinburgh and in Edinburgh generally. The minute-books of the Royal Society of Edinburgh indicate that an even greater proportion of the Society’s proceedings may have been given over to the earth sciences than is reflected in the *Transactions*.

Who were the Edinburgh earth scientists? And how may their involvement in these sorts of cultural activity be related to the local social context? First of all, it is not possible to establish, as one can in medicine, a clear separation between ‘professional’ earth scientists and other sorts of participants. There was no chair of geology at the University of Edinburgh until 1871; geology, mineralogy and meteorology were subsidiary subjects dealt with, in more or less detail, by the professors of natural history, natural philosophy and chemistry. In the Royal Society of Edinburgh participants included Edinburgh professors of mathematics, natural philosophy, natural history, botany and chemistry; ministers; physicians; surgeons; lawyers; printers; gentlemen of leisure and independent means; and landowners, great and small. James Hutton, a Leyden MD, turned to the earth sciences after putting his Berwickshire farm in order and reaping the profits from a partnership in the manufacture of sal ammoniac. Sir James Hall, Bt, succeeded to his father’s East Lothian estate in 1776 and later made an advantageous marriage with a daughter of the Earl of Selkirk. Lesser, yet noteworthy, performers before the Royal Society of Edinburgh included Robert Kennedy, an Edinburgh MD; Colonel Ninian Imrie, retired military man and Fifeshire landowner; Rev. Thomas Macknight, minister of Leith; Sir George Stewart Mackenzie, Bt, of Ross-shire; and Lord John Webb Seymour, a younger son of the Duke of Somerset. In all, one can, from the *Transactions* and the minute-books,



identify at least 28 individuals who made contributions to geology, mineralogy and meteorology in the Royal Society of Edinburgh between 1783 and 1820. Many of these were not men of science in a career sense. Especially in the earth sciences, an absolute demarcation between performer and audience is blurred—interestingly so, as members of the audience felt impelled to participate.

The social composition of this earth sciences sub-community in the Royal Society of Edinburgh is worth examination. Fortythree percent (12) were landowners. This is a much higher proportion than the very significant representation of landowners in the Royal Society of Edinburgh as a whole during these years—eighteen percent. Clearly, the ownership of land and the social roles pertaining to landed status were related to the disposition to cultivate the earth sciences. Another way of appreciating this link is to look at the eighty-seven landowners who were ordinary Fellows of the Royal Society of Edinburgh from 1783 to 1820. Of these landowning Fellows, eighteen percent (16) contributed to the intellectual proceedings of the Society in various ways. Fiftysix percent (9) of participating landowning Fellows contributed to earth sciences and fortyone percent (7) contributed in the areas of agriculture and technology. By way of contrast, fourteen percent of a similar number of lawyer-Fellows made intellectual contributions to the Royal Society of Edinburgh; of these twentyfive percent participated in the earth sciences. Another contrast with the landowning sub-community comes from the eighteen percent (11) of sixtyone Church of Scotland minister-Fellows who made intellectual contributions to the Royal Society of Edinburgh; of this group only eighteen percent (2) were involved with the earth sciences. Landowning Fellows were therefore disposed to participate in their Society's intellectual affairs about as much as certain other categories, but, when they chose to do so, they were far more likely to cultivate the earth sciences.<sup>34</sup>

It is not difficult to identify probable explanations for this pronounced tendency. First of all, it seems a defensible contention that owners of land may, when inclined to take part in organized literate culture, tend to engage in those forms of culture which they recognize as relevant to their primary role activities.<sup>35</sup> This they may do because they regard the study of geological, mineralogical or meteorological phenomena as 'rational amusement' (or theological edification) suitable to their station, or because they perceive such studies as useful in a more concrete sense. The following excerpt from the article on "Meteorology" in the fourth edition of the *Encyclopædia Britannica* manifests each of these inducements:

The importance of the study of meteorology requires little elucidation. . . . In countries like our own, where all the vicissitudes of seasons may take place in the course of a few hours, it is of the highest consequence to investigate the nature of the change, and the circumstances that precede

or accompany it. To the farmer, the mariner, the traveller, the physician, meteorology is in some measure a study of necessity; to the philosopher it is a study of interest and delight; and to the observer of nature it affords objects of grandeur and sublimity not to be found in any other department of his favourite science. Surely nothing can contribute more to elevate the mind of man, to raise it 'from nature up to nature's God', than the contemplation of the sweeping whirlwind, the dazzling lightning, or the awful thunder.<sup>36</sup>

Apprehension of material utility in certain types of cultural activity evidently extended not only to the disposition to cultivate such studies oneself, but also to the disposition to approve, encourage or actively patronize them. All of these tendencies among the landed classes are evident from an examination of the audience for natural knowledge in Edinburgh.

A specific connection between the economic interests of landed gentlemen and a scheme for mineralogical assays by men of science in the Philosophical Society of the 1740s has already been mentioned.<sup>37</sup> Although cooperative research in the early Royal Society of Edinburgh was very limited in extent, there were a number of instances in which groups of prominent Fellows offered to assist landed gentlemen in the making of meteorological observations. In 1788 the Royal Society of Edinburgh appointed a committee consisting of Professors Playfair and Daniel Rutherford and the lawyer Alexander Keith to assess Professor John Walker's plan for keeping a meteorological register. Such a register, maintained by the Duke of Buccleuch, was in fact published in the first volume of the *Transactions*. During the 1790s the Society sponsored a register of Edinburgh weather compiled by Professor Playfair. In 1814, in response to requests for such assistance, Professors Playfair, T. C. Hope and John Leslie were "named as a committee to draw up a convenient form of a Register of the Weather to be recommended to those Gentlemen who keep meteorological journals".<sup>38</sup> Ten years later David Brewster, then General Secretary of the Society, testified to the link between the successful prosecution of local science and the utilitarian justification:

In the year 1820, I had the occasion to suggest to the Royal Society [of Edinburgh] the propriety of establishing Registers of the Thermometer in various parts of Scotland. In a country embracing so many varieties of soil, climate and elevation . . . it was an object worthy of a public body to determine the Law of the Distribution of Temperature, *even if such a subject had not possessed a separate interest in relation to the Horticulture and Agriculture of the Country*.<sup>39</sup>

By 1821 about sixty meteorological journals were being kept throughout Scotland in concert with the Royal Society of Edinburgh, many by landed gentlemen, and aiding the perceived interests of both scientific performers and their agriculturally minded audience.

There is abundant evidence that powerful sections of the local audience approved and, to a marked extent, participated in the cultivation of the earth sciences because they perceived them as useful. It is not germane to the present discussion whether their perceptions of utility were valid or not; a landowner's correct understanding of the Huttonian theory would seem to have had at best a tenuous connection with agricultural productivity, but he might have reasonably expected profit of some sort from employing a surveyor to examine his estate for the presence of coal or minerals.<sup>40</sup> What is important in this connection is that the audience's apprehensions of the appropriateness and concrete utility of these sorts of studies may have been substantially responsible for the demonstrated tendency of local men of science to take up these species of scientific enquiry in preference to others. Having done so, scientific performers might be assured that utilitarian justifications for the earth sciences would find a receptive audience among the landed classes. The agricultural concerns of the landed audience are critical in understanding foci of interest. James Hutton crowned his intellectual activities with a massive, and still unpublished, *Principles of agriculture*. His object, he said, was "in short to make philosophers of husbandmen and husbandmen of philosophers".<sup>41</sup>

Appreciation of the importance of the local audience for scientists' foci of interest should be extended beyond just the Edinburgh context. Late eighteenth century Manchester was the centre of the new factory-based cotton manufacture; to the Manchester Literary and Philosophical Society (founded 1781) Thomas Henry declared his intention to rectify a situation in which "few dyers are chemists, and few chemists dyers". The proportion of manufacturers elected to the Manchester Literary and Philosophical Society rose steadily from eight percent of the founding group to fiftysix percent of the group joining in 1809–11; the corresponding proportion in the Royal Society of Edinburgh was less than four percent. 'Gentlemen' in the Manchester Literary and Philosophical Society from 1781 to 1820 constituted around five percent of the group.<sup>42</sup> The great manufacturers in the Manchester audience, the "aristocracy of the town", were told by Henry that natural history and botany were "improper objects for the man of business to pursue scientifically"; geography, mechanics and chemistry, on the other hand, were highly recommended.<sup>43</sup> In fact, the cultivation of experimental chemistry and physics was important in the Manchester Society; study of the earth sciences was negligible. In the Pottery Philosophical Society of North Staffordshire (founded 1819), performers were encouraged by their social betters, the master-potters, to elucidate the mysteries of chemistry and the nature of heat.<sup>44</sup> Examples of congruence between the areas of enquiry preferentially addressed by performers and the concerns of locally powerful audiences will doubtless be augmented as the study of provincial scientific societies in eighteenth and nineteenth century Britain continues. But part of a programme for local studies seems to emerge; in any local context where men of science

feel themselves to be dependent on or subservient to their non-expert audience the concerns of the audience may be reflected in the activities of the performers.

(2) *Institutionalization and professionalization*

The motto of the city of Edinburgh is *Nisi Dominus, frustra*—liberally translatable as “Unless the Lord is with us, our efforts are vain”. An English lexicographer, recognizing the traditional local importance of aristocratic patronage, has rendered it semi-cynically as “You can do nothing here unless you are a lord”. Certainly, the encouragement and participation of the landed classes made many local enterprises successful which otherwise would have struggled or failed. The celebrated cultural institutions of the Edinburgh Enlightenment—from the Society of Agricultural Improvers, the Select Society and the Philosophical Society to the Society of the Antiquaries of Scotland and the Royal Society of Edinburgh—all benefited materially and socially from the adherence of greater and lesser aristocrats. Legal as well as landed lords frequently supplied social cachet and financial subvention for Edinburgh cultural enterprises. Lord Kames energetically supported the improving labours of the Philosophical Society; the Earl of Buchan encouraged the establishment of natural history museums in both the University and the Society of Scottish Antiquaries; Henry Dundas, Lord Advocate for Scotland, and the Duke of Buccleuch, his Tory colleague, were instrumental in securing the Charter of Incorporation for the Royal Society of Edinburgh. Few cultural institutions of the city could count on effective support for their endeavours unless the lords were with them.

Enough evidence has already been presented to indicate, first, that the landed classes’ involvement in natural knowledge was partly founded on their interest in the improvement of the Scottish economy and, second, that substantial social and cultural power resided in this sector of the Edinburgh audience for science. Hence, the ability successfully to appeal to the concerns of such patrons affected the possibility that certain sorts of cultural activity could be effectively institutionalized. At a most basic level, the landed classes and the great lawyers in the Edinburgh scientific audience commanded financial resources which were not to be found in any other sector of Edinburgh society. The Edinburgh commercial classes were as yet insignificant and politically impotent; local medical men were numerous, but relatively poor. There was no real alternative to seeking cultural patronage and approval among the gentry and aristocrats.<sup>45</sup>

I have attempted to assemble evidence that the landed audience for natural knowledge in the Royal Society of Edinburgh encouraged and sustained performers’ turn towards the cultivation of the earth sciences. Although the Royal Society of Edinburgh’s brief remained all-encompassing, there was a period during the early years of the nineteenth century when it was practically



a specialized institution—a geological society which was flourishing even before the 1807 foundation of the Geological Society of London. At the time the Royal Society of Edinburgh was established there existed in Edinburgh no expressly specialized scientific societies, apart from student groups and the various medical societies. But, from 1784 to the 1830s, a number of disciplinary scientific institutions made their appearance in the city. A brief survey of the nature of these new societies may further illuminate the role of the local audience for scientific culture.

The Earl of Buchan's Society of the Antiquaries of Scotland (founded 1781), although not by constitution a scientific organization, had appealed to its landed members to supply resources for its natural history museum, with a view to becoming a repository of the natural productions of Scotland.<sup>46</sup> Three years later, the Highland and Agricultural Society was instituted, originally numbering over one hundred members and presided over by the Duke of Argyll, the Earl of Moray, Sir James Grant, Bt, and Lord Advocate Islay Campbell.<sup>47</sup> The Highland Society was immensely successful in stimulating agricultural innovation and experimentation, bringing together large numbers of progressively-minded proprietors and men of science in the improving enterprise. In 1789 it was granted the sum of £3000 by Act of Parliament which it began systematically to use in offering premiums for relevant essays and inventions. By the middle of the nineteenth century its membership had expanded to over 2000 and it had its own chemical laboratory, employing a professional chemist. Its *Transactions* are a valuable and untapped source for assessing the involvement of Edinburgh scientists in agricultural technology.

The next specialized institution was that of the Wernerian Natural History Society of Edinburgh, formed in 1808 by Professor Robert Jameson and other Fellows of the Royal Society of Edinburgh discontented with the dominance of the Huttonian circle in the Royal Society.<sup>48</sup> Meeting in the University's Natural History Museum, of which Jameson was Keeper, the Wernerian Society included among its approximately fortyfive resident members a number of landed gentry who had participated in earth science discussion in the Royal Society of Edinburgh. It continued in vigour until the 1830s, publishing eight volumes of *Memoirs* which were largely given over to geology, mineralogy, botany and zoology, before finally merging with two other specialized scientific societies in 1858. In 1809 the Caledonian Horticultural Society was formed in Edinburgh, its President being the Earl of Dalkeith and its other officers including the geologists Sir James Hall and Sir George Stewart Mackenzie; Professor of Medicine Andrew Duncan, Sr; Professor of Botany Daniel Rutherford; Professor of Materia Medica James Home; and Professor of Agriculture Andrew Coventry.<sup>49</sup> Its membership ranged from the greater aristocracy to professional gardeners employed by the aristocracy, and it, like the Highland Society (although on a smaller scale), set prize essays and



awarded premiums for exemplary produce. Within a few years it was soliciting private subscriptions to supplement a government grant for the maintenance of its own experimental garden. In the case of the both the Caledonian Horticultural Society and the Highland and Agricultural Society, there was considerable overlap of membership with those involved in the earth sciences in the Royal Society of Edinburgh. Seven of the twentyeight 'earth scientists' in the Royal Society of Edinburgh belonged to the Caledonian Horticultural Society; nine of the same twentyeight belonged to the Highland and Agricultural Society. Interest in the sciences relating to the earth seems to have been related to interest in practical agriculture or at least the willingness to encourage such efforts.

Before the end of the 1830s a number of other specialized scientific societies had formed in Edinburgh. The 1834 Geological Society of Edinburgh seems not to have had a significant landed membership, and was perhaps intended to differ in social tone from alternative earth science institutions. "Its members", according to an official account, "consisted of gentlemen all of whom were engaged in business, but who were inspired with a desire to dignify and adorn their hours of recreation by scientific pursuits, and relieve the monotonous routine of their daily avocations by the pleasures arising therefrom".<sup>50</sup> The Geological Society met with only limited success and did not begin to publish its proceedings until 1870. The 1836 Botanical Society of Edinburgh maintained a large herbarium, from which it circulated specimens to members desirous of augmenting their private collections. "With a view to extend the range, and increase the utility of [botanical studies]", it was "deemed proper to embrace also what may be termed the Botany of Agriculture".<sup>51</sup>

The societies mentioned above do not exhaust the list of specialized societies concerned in whole or in part with natural knowledge which were established in Edinburgh from 1780 until the late 1830s. The technologically oriented Society of Scottish Arts (founded 1821) was an important force in encouraging the application of science to commerce and manufacturing. The Phrenological Society (founded 1820), in which the Combes and Sir George Stewart Mackenzie were active participants, supplies an intriguing example of the perceived social uses of mental science. The impression should not be given that the local landed classes were the only elements of Edinburgh society to provide an audience for science. As the nineteenth century wore on and as the local commercial classes became wealthier and socially more confident, numbers of manufacturers and businessmen began to participate in organized scientific culture. But during the eighteenth and early nineteenth centuries the landed classes and the great lawyers had at their disposal social and economic power unmatched by any other sector of Edinburgh society. It was therefore relatively easy to secure institutional bases for scientific studies which could attract the encouragement and support of the landed segment of the local cultural audience. The earth sciences, scientific agriculture, horti-

culture, natural history and botany all could and did successfully appeal to the landed classes for institutional patronage and subvention. On the other hand, the 1818 Astronomical Institution had a desperate time assembling the financial resources to erect and operate an observatory; mathematics was not institutionalized in a distinct local society until 1883.

I have concentrated thus far on the formation of specialized scientific societies as an indication of the conditioning effect of the local audience for science. But such influences have already been noted in the context of individual scientific careers. The establishment in 1790 of the Edinburgh chair of agriculture is a prime example of professionalization facilitated by the patronage of landed gentry. Edinburgh professors whose professional careers were advanced through their connections with landed patrons are legion. Lord Kames arranged for John Walker's natural history survey of the Highlands and Islands via his influence with the Society for Propagating Christian Knowledge in Scotland. During these expeditions Walker accomplished the work which weighed heavily in his eventual appointment as professor of natural history. Similar encouragement and assistance from Kames was received by Joseph Black and William Cullen, insofar as they were ready to employ their scientific talents in the cause of the improvement of agriculture and chemical technology. Both Kames and the Earl of Buchan sponsored aspects of the scientific work of William Smellie—translator of Buffon, editor of the first edition of the *Encyclopædia Britannica*, and Curator of the Society of Scottish Antiquaries' Museum. The path to a serious scientific career was markedly smoother for a man whose studies could marshal patronage of this sort than for one whose chosen pursuits failed to resonate with the concerns of the most powerful classes of local society. The effects of such connections between audience and performer on the thematics and dynamics of the scientific enterprise cannot be easily ignored. Nor can we avoid the conclusion that the nature of these connections are locally determined.

### (3) *Styles of scientific activity*

The nature of relations between geographically rooted 'styles' of scientific activity and local social contents remains largely unexplored. Indeed, there is considerable disagreement over what styles in science consist of; whether they exist; whether, if they once existed, they still do; whether, if they can be shown to exist, they are important objects of study. J. T. Merz's classic treatment of "the scientific spirit" in nineteenth century Germany, France and England is familiar to all historians of science. Yet Merz felt it was becoming impossible, by the late nineteenth century, to speak of national styles in *science*:

National peculiarities still exist, but are mainly to be sought in those remoter and more hidden recesses of thought, where the finer shades,

the untranslatable idioms, of language suggest, rather than clearly express, a struggling but undefined idea.<sup>52</sup>

Maurice Crosland has qualified his recent survey of French science by reminding the reader that "science . . . is an international activity and the fact that it is carried out on one side of the Rhine, of the Alps, of the Pyrenees, or of the English Channel does not in itself make it different".<sup>53</sup> Robert Fox, concluding his attempt to account for "the public, rhetorical style of post-Restoration science [in France], with its accompanying attitudes towards research", attributes this style to "a question of national characteristics, a consequence of 'the peculiar character of the French mind'".<sup>54</sup> In connection with Scotland, one must mention Buckle's claim to have identified and traced a 'deductive tendency' in "the Scotch intellect", which, he argued, permeated all areas of culture—mental and moral philosophy, medicine, chemistry, geology, etc.<sup>55</sup> Buckle's opinion that this deductive tendency arose from Scotland's domination by a tyrannical Presbyterian clergy was both highly simplistic and politically motivated. But Davie's treatment of "The Humanistic Bias of Scottish Science" goes some way towards articulating Buckle's insights and grounding them in the bed-rock of local cultural and political circumstances.<sup>56</sup> I am reluctant, in this connection, to state with the required brevity and simplicity what the Scottish style of science actually was. Fortunately, there are a number of competent and sensitive essays to which one can refer: Cantor analyzes the significance of the Scottish methodological tradition, with its strong (but ambivalent) attitudes to the place of 'conjecture' and 'generalization';<sup>57</sup> Olson examines the emphasis on geometry in Scottish mathematics and suggests that we look to the institutional framework of Scottish education for the peculiar relation that existed between mathematics and epistemology;<sup>58</sup> Morrell relates the conditions of the Edinburgh professorial role to the style of scientific teaching.<sup>59</sup> The major reason for the tentativeness of the following discussion of the local scientific style is that I wish to see what may be learned by approaching the question from the standpoint of the performer-audience link. Whether the style of local scientific activity revealed from this vantage clearly connects with the work of the authors mentioned above is a matter for further study.

Although, as we have seen, a number of specialized scientific societies were instituted in early nineteenth century Edinburgh, they were on the whole less successful than analogous organizations in London. The Royal Society of Edinburgh could never match the Royal Society of London in wealth or in the quality of its proceedings; the Wernerian Natural History Society was similarly outweighed by both the Linnean Society and the Geological Society of London. No provincial city, not even "the Athens of the North", could withstand the centripetal cultural pull of London. Approximately ten times bigger than Edinburgh in 1800, London was a vast reser-

voir of opportunity which alone among British cities could successfully sustain an array of seriously specialized scientific institutions. Disciplines which found little or no social support in Edinburgh were securely institutionalized in the southern metropolis, *viz* the Geographical, Astronomical, Entomological and Zoological Societies of London.

London was not only bigger than Edinburgh, it was also richer and its wealth was spread over a larger set of culturally and socially differentiated groups. This implied the possibility of sustaining more highly differentiated cultural endeavours—a fact not lost on the leaders of the Edinburgh scientific enterprise in the nineteenth century. In 1862 James David Forbes told the Royal Society of Edinburgh that

The largest provincial town or district cannot possibly maintain the group of associations which, even in London, may be said to enjoy a precarious intellectual subsistence.

Commenting on what he saw as the decline of Scottish science, Forbes identified

that tendency to *centralization* which, during the last half century, has affected so many interests, political, social, commercial, and also scientific and literary. The facility of communication with London has facilitated that tendency to southward emigration, so long, and not unjustly, attributed to Scotchmen. . . . The larger arena for practical talent to be found in the metropolis attracts . . . our labourers in the cause of physical science. It is a fact which admits of no doubt, that the Scottish Geological School, which once made Edinburgh famous . . . may almost be said to have been transported bodily to Burlington House. . . . Our younger men are drafted off as soon as their acquirements become known.<sup>60</sup>

Centralization of British science in the mid-nineteenth century was recognized as an irreversible process; the task confronting the Edinburgh scientific community was to survive, and survival entailed readjustment to social realities. Forbes argued that the healthy existence of the Royal Society of Edinburgh as a scientific society required its ability to attract and interest an audience of the generally literate. Regretting the fall in attendance at the meetings of the Royal Society of Edinburgh, he reflected on the relative decline in participation by “that large band of our fellow-citizens, our professors, our distinguished lawyers, our country gentlemen and mere amateurs” who used to be attracted by “the social spirit of coming together for common objects”, less than a generation before.

The solution Forbes recommended to local scientists was to guard against overly technical, specialized or fragmentary scientific communications which would tend to alienate or bore the necessary audience of the partially initiate:



"I fear, gentlemen, that we now-a-days allow ourselves to become too mechanically intellectual, and also too intellectually fastidious".<sup>61</sup> Scientific culture in Edinburgh ought to be *pleasing* and ought to be communicated in a style which was able to "promote a cordial feeling amongst those (at best but a small number in the midst of a teeming and busy population) who profess an interest in the progress of literature and science, and whose presence and conversation may contribute to this end, as well as the more formal contributions of others". What was needed was "a *social* form of scientific and literary effort". Whether Forbes's advice to Edinburgh scientists of the 1860s produced its intended effects or not, one must appreciate the keenness of his insights into the role of the local audience in past years. The putative humanistic bias of Scottish science partially consisted in its social inclusiveness, its willingness to relate scientific matters to the affairs of everyday life, its predilection for common 'rational' principles, its links with classical learning, and its abhorrence of the esoteric. Again, no judgment is made as to the existence of these stylistic components or their influence on the actual content of scientific ideas. But, *if* they can be shown to exist, it is not difficult to see how they may be related to the nature of the local connections between men of science and their social context. From the middle of the eighteenth century, Edinburgh (and Scotland as a whole) was producing a far greater proportion of scientific intellectuals in relation to its population than was, for example, England. Its four ancient universities educated a population a tenth the size of England, served only by Oxford and Cambridge in the eighteenth century. Competition between trained men of science for limited social resources was intense. The successful scientific intellectual was more likely than not to be one who could relate his interests to those of the powerful classes in his audience, who could make scientific culture seem pleasing, who could effectively argue the connections between science and general culture, and who could structure his scientific communications around the traditional humanistic and philosophical basis of Scottish university education. Some of these conditions for success in science may be seen to have a bearing on the postulated Scottish style of science, and all of them depend on the relations between men of science and the local audience.

# V

Local studies of the social relations of science are by no means a new development in the history of science. However, the relative lack of historiographic introspection which has gone into these studies has, with few exceptions, been apparent. The *Isis critical bibliography's* classificatory scheme is interesting in this connection. Section D ("Chronological Classification") specifies the geographical setting only for studies of pre-1600 science, *e.g.* "India, to *c.* 1600"; "Pre-Columbian America, to *c.* 1500"; "The Far East, to *c.* 1600". From the "Renaissance and Reformation, 1450–1600" onwards,



science seems to be regarded as a universal and unitary activity, and scholarly work is classified according to time-period alone. Section B contains work on "Scientific Institutions", "Social Relations of Science" and "Humanistic Relations of Science", and is not broken down by place or time-period. Section B is called "Science and its History from *Special Points of View*" and it is very short; the ninetyseventh *Critical bibliography* devoted sixteen pages to Section B and 120 pages to Section D. It will be interesting to see where this paper goes.

There now exists a large corpus of historical research on science in France, science in America, in Oxford, in Prussia, and, not least, on science in Edinburgh. A number of pitfalls await us as we pursue such local studies: we can quibble about whether it is proper to speak of Scottish science or science in Scotland (and very likely never reach consensus); we can justify localism solely in terms of the *quality* of science produced in a given context (thus imposing internalist evaluative assumptions on our work); or we can continue as we have been, ultimately writing accounts of "Natural History in Berwickshire, 1800–1851" solely because no one has done so before. Hopefully, we shall reflect on localism and its place in the history of science and recognize that the cultural context of scientific activity is worthy of historical attention and that the cultural and social context of science must be specified. If we fail to reflect on the significance of localism, we shall indeed be in danger of "slipping into myopic piecemeal empiricism";<sup>62</sup> if we do, we may be able to see our way into rendering the sociology of scientific knowledge concrete.

## REFERENCES

1. For permission to use manuscripts under their care, I am grateful to the Royal Society of Edinburgh; Mr C. P. Finlayson, Keeper of Manuscripts, Edinburgh University Library; and the Trustees of the National Library of Scotland. I should like to acknowledge the helpful criticism of Barry Barnes, John Christie, J. B. Morrell and James O'Rourke.
2. See the suggestive work of Georges Gurvitch, "The sociology of the theatre", and Elizabeth Burns, "Conventions of performance", in Elizabeth and Tom Burns (eds), *Sociology of literature and drama* (Harmondsworth, 1973), 71–81, 348–58.
3. E.g. Yaron Ezrahi, "The political resources of American science", *Science studies*, i (1971), 117–33; Charles Rosenberg, "Science and American social thought", in D. Van Tassel and M. G. Hall (eds), *Science and society in the United States* (Homewood, Illinois, 1966), 137–84. Cf. Paul Forman, "Weimar culture, causality, and quantum theory, 1918–1927: adaptation by German physicists and mathematicians to a hostile intellectual environment", *Historical studies in the physical sciences*, iii (1971), 1–115. For a sophisticated discussion of the role of audiences in scientific thought, see R. G. A. Dolby, "Sociology of knowledge in natural science", *Science studies*, i (1971), 3–21, especially 16–21.

4. Amitai Etzioni usefully categorizes kinds of power as “coercive”, “remunerative” and “normative”. In the following discussion of audience power I shall almost exclusively be dealing with the latter two varieties: *A comparative analysis of complex organizations* (New York, 1961), 3–22.
5. An interpretation of professionalization partly identified with the work of Joseph Ben-David: *The scientist's role in society* (Englewood Cliffs, New Jersey, 1971).
6. See, however, the treatment of the ideology of scientific internationalism in the context of post-World War I Germany in Paul Forman, “Scientific internationalism and the Weimar physicists: the ideology and its manipulation in Germany after World War I”, *Isis*, lxiv (1973), 151–80.
7. John Christie, “The origins and development of the Scottish scientific community, 1680–1769”, *History of science*, xii (1974), 122–142.
8. Materials for the history of medicine in eighteenth century Edinburgh may be found in J. D. Comrie, *History of Scottish medicine* (2 vols, 2nd ed., London, 1932).
9. These, and subsequent remarks on the founding of the Royal Society of Edinburgh draw on Steven Shapin, “Property, patronage, and the politics of science: the founding of the Royal Society of Edinburgh”, *The British journal for the history of science*, vii (1974), 1–41.
10. Fourteen of the fortyseven members in 1739 were medical men (of whom nine were professors); eleven were landed gentlemen; six were lawyers, and three were clerics. By 1782 (the last year of the Philosophical Society's existence), thirtyone of the sixty members were medical men (of whom thirteen were professors).
11. Only one article in the Society's *Essays and observations* specifically dealt with antiquarian subjects, whereas almost two-thirds were on the medical sciences or related topics. However, as the *Essays and observations* were edited by medical professors, these proportions may not be a just reflection of the Society's actual affairs.
12. For discussion of the cultural concerns of the Edinburgh Enlightenment, see T. C. Smout, *A history of the Scottish people, 1560–1830* (London, 1969), especially 500–14; and N. T. Phillipson, “Culture and society in the eighteenth-century province: the case of Edinburgh and the Scottish Enlightenment”, in Lawrence Stone (ed.), *The university in society* (Princeton, New Jersey, 1974, in the press).
13. See, for example, this intriguing defence of ‘reason’ in agriculture: “Why . . . should Reason be so little exercised, as generally it is, in this Matter of the greatest Importance? . . . Reason, which is the Dignity of our Nature, and gives us the Pre-eminence over the Beasts of the Field, some of which can do what they are habitually accustomed to, and even follow Examples nigh as well as the Husbandman who does not reason in order to find out the Causes of different Consequences”. Robert Maxwell, *Select transactions of the Honourable the Society of Improvers in the Knowledge of Agriculture in Scotland* (Edinburgh, 1743), xiii.
14. Robert Christison, “Opening address [to meeting of the Royal Society of Edinburgh], 7th December 1857”, *Proceedings of the Royal Society of Edinburgh*, iv (1857–62), 2–29, p. 4.
15. James David Forbes, “Opening address [to meeting of the Royal Society of Edinburgh], 1st December 1862”, *Proceedings of the Royal Society of Edinburgh*, v (1862–66), 2–51, p. 6.

16. David Brewster, "Review of Babbage's *Decline of Science in England*", *Quarterly review*, xliii (1830), 305–42, p. 325n.
17. See H. G. Graham, *The social life of Scotland in the eighteenth century* (London, 1906), especially chs v–vi; Smout, *op. cit.* (ref. 12), 280–301.
18. On eighteenth century Scottish agriculture, see James Handley, *Scottish farming in the eighteenth century* (London, 1953), and *The agricultural revolution in Scotland* (Glasgow, 1963).
19. The scientific validity of the new knowledge demanded, as well as the practical efficacy of the innovative techniques, was often doubtful at best. The Society of Agricultural Improvers gave considerable attention to Jethro Tull's scheme for repeated cross-ploughing which was based on the theory that the sole food of plants was earth itself. Cf. Maxwell, *op. cit.* (ref. 13), 174–85.
20. A contemporary account of the Society's origins is in Maxwell, *ibid.*, 3–9.
21. *Ibid.*, x, xiii. Under the patronage of Sir William Pulteney a chair of agriculture was established in the University of Edinburgh in 1790, the first in a British university.
22. *Scots magazine*, v (1743), 385.
23. Henry Home, Lord Kames, *The gentleman farmer, being an attempt to improve agriculture, by subjecting it to the test of rational principles* (3rd ed., Edinburgh, 1788), 405–6n. For correspondence between Lord Kames and Edinburgh scientists, see Alexander Fraser Tytler, *Memoirs of the life and writings of the Hon. Henry Home of Kames* (2nd ed., 3 vols, Edinburgh, 1814), vol. iii, 191 ff. A national Board of Agriculture was finally established in the 1790s on the initiative of Sir John Sinclair of Ulbster, FRSE.
24. Letter from Kames to Cullen, 25 March 1753, National Library of Scotland ms. Acc. 3795: Kames to Cullen, 3 March 1753, NLS ms. Acc. 3892. In 1756 Dr Francis Home, later Professor of Materia Medica at the University of Edinburgh, won a gold medal from the Board of Trustees for his *Experiments on bleaching*.
25. Handley, *The agricultural revolution in Scotland* (Glasgow, 1963), 83; Alexander Ramsay, *History of the Highland and Agricultural Society of Scotland* (Edinburgh, 1879), 449.
26. Ramsay, *ibid.*, 47–8.
27. At least from the evolution of effective means of international information dissemination in the seventeenth century. If, on the other hand, it can be clearly demonstrated that men of science in various contexts perceive different lines of research as differentially interesting owing to local cultural predispositions, the general significance of the contextual approach is enhanced.
28. Robert K. Merton, *Science, technology and society in seventeenth century England* (New York, 1970; orig. publ. 1938), esp. chs iii, vii–x; B. Hessen, "The social and economic roots of Newton's *Principia*", in N. I. Bukharin *et al.* (eds), *Science at the cross roads* (London, 1971; orig. publ. 1931), 151–229.
29. Note Merton's cautious statement that "it may be argued that the disinterested search for truth coupled with the logical concatenation of scientific problems is sufficient to account for the particular direction of research. In point of fact, however, a cumulating body of evidence leads to the conclusion that *some* role must be accorded these factors external to science, properly so-called". Merton, *ibid.*, 198. See also the qualifying responses to Hessen and Merton by G. N. Clark, *Science and social welfare in the age of Newton* (2nd ed., London, 1949), and A. R. Hall, *Ballistics in the seventeenth century* (Cambridge, 1952).

30. A methodological approach in this area has been made by Steven Shapin and Arnold Thackray, "Prosopography as a research tool in history of science: the British scientific community, 1700–1900", *History of science*, xii (1974), 1–28.
31. John Playfair, "Biographical account of the late Dr James Hutton, F.R.S. Edin.", *Transactions of the Royal Society of Edinburgh*, v (1805), 39–99, p. 50. A year earlier Hutton had delivered to the Royal Society of Edinburgh his Theory of Rain, also published in the first volume of the *Transactions*.
32. David Brewster, "Presidential address [to the Royal Society of Edinburgh]", *Proceedings of the Royal Society of Edinburgh*, v (1862–66), 321–26, p. 323.
33. Cf. James Hall, "Experiments on whinstone and lava", *Transactions of the Royal Society of Edinburgh*, v (1805), 43–75, p. 45, where Hutton is quoted as criticizing those who "judge of the great operations of the mineral kingdom, from having kindled a fire, and looked into the bottom of a little crucible". For background to Edinburgh geology, see G. L. Davies, *The earth in decay: a history of British geomorphology 1578–1878* (London, 1969), chs v–vi; and C. C. Gillispie, *Genesis and geology* (Cambridge, Mass., 1951), chs ii–iii.
34. By way of contrast, those who contributed to mathematics in the Royal Society of Edinburgh during this period numbered only eight; none was a landowner.
35. This is not to claim that landowners, as a class, will tend to cultivate the earth sciences. My data deal only with landowners in the Royal Society of Edinburgh and other societies, not with the proportion of landowners in Scotland who chose to participate in these forms of culture. However, it was possible to pursue all sorts of intellectual activity in the Royal Society of Edinburgh and it is therefore instructive that landowning Fellows chose the earth sciences.
36. *Encyclopaedia Britannica* (4th ed., Edinburgh, 1810), xiii, 705–35, p. 706. See similar rhetoric in the article on "Geology", vol. ix, 550–628, p. 551.
37. See ref. 22.
38. Minute-book of the Royal Society of Edinburgh, 1793–1824 (meeting of 7 February 1814).
39. *Transactions of the Royal Society of Edinburgh*, x (1824–26), 362 (my italics); see Minutes of the Royal Society of Edinburgh General Council, 1821–1827, for a list of the registers established.
40. Cf. Roy Porter, "The Industrial Revolution and the rise of the science of geology", in M. Teich and R. Young (eds), *Changing perspectives in the history of science* (London, 1973), 320–43. Porter argues that geological science in Britain did not respond "in any immediate way, to social conditions".
41. E. B. Bailey, *James Hutton—the founder of modern geology* (Amsterdam, 1967), 10. Hutton's MS is in the archives of the Royal Society of Edinburgh.
42. Arnold Thackray, "Natural knowledge in cultural context: the Manchester model", *American historical review*, lxxix (1974), in the press.
43. Thomas Henry, "The advantages of literature and philosophy", *Memoirs of the Literary and Philosophical Society of Manchester*, i (1785), 7–29, pp. 18, 23; cited in Thackray, *ibid.*
44. Steven Shapin, "The Pottery Philosophical Society, 1819–1835: an examination of the cultural uses of provincial science", *Science studies*, ii (1972), 311–36; cf. Morris Berman, "The early years of the Royal Institution 1799–1810: a re-evaluation", *Science studies*, ii (1972), 205–40, for a discussion of the relationship between scientific activity in the Royal Institution and the concerns of landowning Proprietors.



45. For a comment on the cultural impotence of the Edinburgh commercial classes, see Henry Cockburn, *Memorials of his time* (Edinburgh, 1909; orig. publ. 1856), 164–5.
46. Discussion of the controversy attending the formation of the Antiquaries' museum is in Shapin, *op. cit.* (ref. 9).
47. Ramsay, *op. cit.* (ref. 25), 539–51.
48. Accounts of the Society may be found in [Robert Jameson], "Some account of the Wernerian Natural History Society of Edinburgh", *Blackwood's Edinburgh magazine*, i (1817), 231–4; Laurence Jameson, "Biographical memoir of the late Professor Jameson", *Edinburgh new philosophical journal*, lvii (1854), 1–49. Membership lists are in the Society's *Memoirs*.
49. *Memoirs of the Caledonian Horticultural Society*, i ([2nd ed.], 1819), 1–48; "Sketch of a plan for the establishment of a horticultural society at Edinburgh", *Scots magazine*, lxxi (1809), 805–6.
50. "Memoir of the Society", *Transactions of the Edinburgh Geological Society*, i (1870), 1–6.
51. *The Botanical Society of Edinburgh* (Edinburgh, 1840), 4; *First annual report, laws, and transactions of the Botanical Society of Edinburgh* (Edinburgh, 1837).
52. John Theodore Merz, *A history of European thought in the nineteenth century* (4 vols, New York, 1965; orig. publ. Edinburgh, 1904–12), i, 19. Stanley Goldberg quotes part of Merz's remark and then proceeds to show that national differences in science did persist into the twentieth century: "In defense of ether: the British response to Einstein's special theory of relativity, 1905–1911", *Historical studies in the physical sciences*, ii (1970), 89–115.
53. "The history of French science: recent publications and perspectives", *French historical studies*, viii (1973), 157–71, p. 157.
54. "Scientific enterprise and the patronage of research in France 1800–70", *Minerva*, xi (1973), 442–73, p. 473.
55. Henry Thomas Buckle, *History of civilization in England* (3 vols, London, 1903–04; orig. publ. 1857–61), iii, ch. v ("An examination of the Scotch intellect during the eighteenth century").
56. George Elder Davie, *The democratic intellect: Scotland and her universities in the nineteenth century* (2nd ed., Edinburgh, 1964), chs v–viii.
57. G. N. Cantor, "Henry Brougham and the Scottish methodological tradition", *Studies in history and philosophy of science*, ii (1971–72), 69–89.
58. Richard Olson, "Scottish philosophy and mathematics 1750–1830", *Journal of the history of ideas*, xxxii (1971), 29–44.
59. J. B. Morrell, "The University of Edinburgh in the late eighteenth century: its scientific eminence and academic structure", *Isis*, lxii (1971), 158–71; *idem*, "Science and Scottish university reform: Edinburgh in 1826", *The British journal for the history of science*, vi (1972), 39–56.
60. Forbes, *op. cit.* (ref. 15), 16–17.
61. *Ibid.*, 21.
62. J. B. Morrell, "Reflections on the history of Scottish science", *History of science*, xii (1974), 81–94, p. 86.